CLAIMS

We Claim:

1. An encapsulation vesicle for an assay, comprising:
   (a) a matrix having a surface;
   (b) a surface coating on said matrix;
   (c) a protection layer encapsulating said surface coating for protecting said surface coating from a quencher molecule; and
   (d) a ligand attached to said protection layer.

2. An encapsulation vesicle as recited in claim 1, wherein said matrix is a sol gel material.

3. An encapsulation vesicle as recited in claim 1, wherein said matrix surface comprises silica and synthetic polymer.

4. An encapsulation vesicle as recited in claim 1, wherein the matrix surface is modified with carboxyl groups so that organometallic complexes can be covalently attached to the surface.

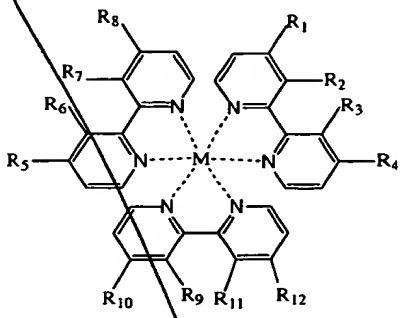
5. An encapsulation vesicle as recited in claim 1, wherein the matrix surface is modified with amino groups so that organometallic complexes can be covalently attached to the surface.

6. An encapsulation vesicle as recited in claim 3, wherein the matrix is modified so that long lifetime fluorophores can be either absorbed or covalently linked to the matrix.

7. An encapsulation vesicle as recited in claim 1, wherein said surface coating comprises at least one donor molecule.

8. An encapsulation vesicle as recited in claim 7, wherein said donor molecule is an organometallic material.

9. An encapsulation vesicle as recited in claim 8, wherein said donor molecule is:



where M is s selected from the group consisting of Ru, Os and Re;

R_1 is selected from the group consisting of H, alkyl, aryl, and aryls leading to a non-substituted or substituted phenanthroline;

R_2 is selected from the group consisting of H, alkyl, aryl, and aryls leading to a non-substituted or substituted phenanthroline;

R_3 is selected from the group consisting of H, alkyl, aryl, and aryls leading to a non-substituted or substituted phenanthroline;

R_4 is selected from the group consisting of H, alkyl, aryl, and aryls leading to a non-substituted or substituted phenanthroline;

R_5 is selected from the group consisting of H, alkyl, aryl, and aryls leading to a non-substituted or substituted phenanthroline;

R_6 is selected from the group consisting of H, alkyl, aryl, and aryls leading to a non-substituted or substituted phenanthroline;

R_7 is selected from the group consisting of H, alkyl, aryl, and aryls leading to a non-substituted or substituted phenanthroline;

R_8 is selected from the group consisting of H, alkyl, aryl, and aryls leading to a non-substituted or substituted phenanthroline;

R_9 is selected from the group consisting of H, alkyl, aryl, and aryls leading to a non-substituted or substituted phenanthroline;

R_{10} is selected from the group consisting of H, alkyl, aryl, and aryls leading to a non-substituted or substituted phenanthroline;

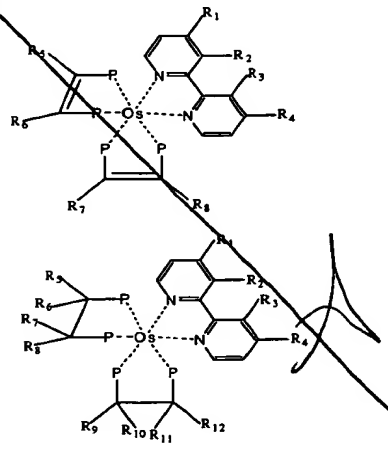
R_{11} is selected from the group consisting of H, alkyl, aryl, and aryls leading to a non-substituted or substituted phenanthroline; and

R_{12} is selected from the group consisting of H, alkyl, aryl, and aryls leading to a non-substituted or substituted phenanthroline.

10. An encapsulation vesicle as recited in claim 8, wherein said organometallic material is a ruthenium tris diphenyl phenanthroline complex.

11. An encapsulation vesicle as recited in claim 8, wherein said organometallic material has an emission at about 650 nm.

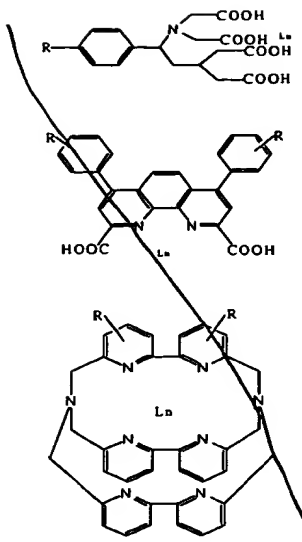
12. An encapsulation vesicle as recited in claim 8, wherein the donor molecule is selected from the group consisting of:



where R_1, R_2, R_3, R_4, represent H, alkyl, aryl, aryl leading to the formation of non-substituted or substituted phenanthroline; and

wherein R_5, R_6, R_7, R_8, R_9, R_{10}, R_{11}, R_{12} represent H, alkyl, aryl, aryl leading to the formation of ortho-aromatic phosphines.

13. An encapsulation vesicle as recited in claim 8, wherein said donor molecule is selected from the group consisting of:



where Ln = Eu, Tb, Sm, Dy, and R represents H or a functionality capable of covalently linking to a matrix .

14. An encapsulation vesicle as recited in claim 8, wherein the donor molecule is any molecule having a fluorescence lifetime greater than 100 nanoseconds and the molecules are susceptible to quenching by oxygen.

15. An encapsulation vesicle as recited in claim 2, wherein said protection layer comprises a translucent material.

16. An encapsulation vesicle as recited in claim 2, wherein said protection layer comprises a transparent material.

17. An encapsulation vesicle as recited in claim 2, wherein said protection layer comprises sol-gel (silica) and synthetic polymers.

18. An encapsulation vesicle as recited in claim 2, wherein said protection layer is modified with hydrophilic functionalities selected from the group consisting of hydroxyl, carboxyl and protonated amines.

19. An encapsulation vesicle as recited in claim 2 that was formed by suspension polymerization.

20. An encapsulation vesicle as recited in claim 1, wherein said ligand attached to said protection layer further comprises an acceptor molecule capable of receiving energy transfer from said donor molecule of said surface coating.

21. An encapsulation vesicle as recited in claim 1, wherein said assay is an immunoassay.

22. An encapsulation vesicle as recited in claim 3, further comprising a ligand attached to the protection layer and having an acceptor molecule capable of receiving energy transfer from a donor molecule.

23. An encapsulation vesicle as recited in claim 1, wherein the acceptor's absorption band overlaps with the emission band of the donor.

24. An encapsulation vesicle as recited in claim 1, wherein the acceptor is selected from the group consisting of fluorescein, Cy5 and allophycocyanin.

25. An encapsulation vesicle as recited in claim 1, wherein said ligand is an antibody.

26. An encapulation vesicle as recited in claim 1, wherein said assay is a sandwich assay.

27. An encapsulation vesicle as recited in claim 1, wherein the biomolecule is selected from the group consisting of proteins, DNA, RNA, polypeptides, aptamers and receptor molecules.

28. A method of quantifying an analyte in a sample, comprising the steps of:

(a) mixing a first binding molecule with a second binding molecule, wherein the first binding molecule competes with an analyte for binding the second binding molecule, wherein one of the first and

second binding molecules is labeled with a photoluminescent energy transfer donor and the other is labeled with a photoluminescent energy transfer acceptor, wherein the photoluminescent energy transfer donor and acceptor are chosen such that when the first binding molecule binds to the second binding molecule, the donor and acceptor are brought into intreracting proximity, producing a detectable luminescence change in the donor;

(b) encapsulating a second binding molecule;

(c) exposing the sample to an exciting amount of radiation;

(d) detecting the resulting emission; and

(e) calculating the apparent luminescence of the donor to quantify binding of the first binding molecule to the second binding molecule and thereby inversely quantifying the analyte.

29. The method of claim 29, wherein the photoluminescent donor is selected from the group consisting of cyanines, oxazines, thiazines, porphyrins, phthalocyanines, fluorescent infrared-emitting polynuclear aromoatic hydrocarbons, phycobiliproteins, squaraines and organo-metallic complexes.

30. The method of claim 29, where the photoluminescent acceptor is selected from the group consisting of cyanines, oxazines, thiazines, porphyrins, phthalocyanines, polynuclear aromatic hydrocarbons, phycobiliproteins, squaraines, organo-metallic complexes, and azo dyes.

31. The sandwich method of quantifying an analyte in a sample, comprising the steps of:

(a) mixing a first binding molecule with a second binding molecule, wherein the first binding molecule competes with an analyte for binding the second binding molecule, wherein one of the first and second binding molecules is labeled with a photoluminescent energy transfer donor and the other is labeled with a photoluminescent energy transfer acceptor, wherein the photoluminescent energy transfer donor and acceptor are chosen such that when the first binding molecule binds to the second binding molecule, the donor and acceptor are

brought into intreracting proximity, producing a detectable luminescence lifetime change in the photoluminescence lifetime of the donor; Δ from 28

(b) encapsulating a second binding molecule;

(c) exposing the sample to an exciting amount of radiation;

(d) detecting the resulting emission; and

(e) calculating the apparent luminescence lifetime of the donor without the use of a fluorescence intensity measurement to quantify the immune complex, thereby quantifying the analyte.

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